ORIGINAL RESEARCH

Depressive symptoms and the relationship of stress, sleep, and well-being among NICU mothers

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Abstract

Objective: To compare the level of self-reported perceived global and situational stress, sleep disturbance, and the level of wellness between mothers with an infant in Neonatal Intensive Care Units (NICU) who are categorized as having high or low depressive symptoms.

Methods: Cross-sectional comparative design which included 55 first-time mothers who were in their second postpartum week and had a preterm infant admitted to the NICU of three urban hospitals in the southeastern United States. Participants wore wrist actigraphy and completed sleep diary for 2-3 days, in addition to completing self-report questionnaires for depressive symptoms, stress, perceived sleep disturbance, and well-being. Participants were categorized as having high (≥ 13) or low (< 13) depressive symptoms by using the total score of Edinburgh Postnatal Depression Scale.

Results: Approximately 62% of the study participants reported high depressive symptoms. Mothers with high depressive symptoms reported greater stress and less well-being compared to those with less depressive symptoms. With the exception of wake after sleep onset, there was no statistically significant difference in the sleep between the two groups; all of the mothers had clinically significant poor sleep.

Conclusions: Mothers of infants in the NICU who experienced higher depressive symptoms also reported greater stress and experienced poorer sleep; altogether, this may compromise one's ability to learn and care for a child in the NICU. Nurses and members of the healthcare team should be attuned to signs and symptoms of depression, perhaps incorporating more formal screening of mothers, educational and support resources, and referral systems.

Key words

Postpartum depression, NICU, Sleep, Stress, Fatigue, Well-being, Preterm infant, First-time mother

1 Introduction

Depression is prevalent in postpartum women, particularly for the women with preterm infants [1-3]. Preterm birth may be a pivotal event that bears unanticipated challenges to a mother's physical and emotional well-being. An estimated 9%-16% of women have postpartum depression (PPD) [1] while over half experience clinically significant depressive symptoms [2]. For mothers with preterm infants, however, the PPD rate is nearly 40% in the early postpartum period [3]. Approximately

13% of the neonates born in the United States each year are preterm births (less than 37 weeks gestation). Preterm birth is a distressing event that could have a negative impact to maternal well-being and quality of life [4-7].

The cause of PPD is unclear [8]; however, there is mounting evidence that PPD has a multifaceted etiology with biological (e.g. endocrine changes), psychological (e.g. stress), and psychosocial (e.g. social support) underpinnings [9-11]. Studies over the past two decades have identified predictors of PPD as prenatal depression and anxiety, life stress, childcare stress, lack of social support, low socioeconomic status, low self-esteem, and poor marital status [12, 13]. Common to each predictor is a given level of stress—a sense of threat, helplessness, or vigilance that is evoked by an acute stress event (i.e. life change) or chronic stress exposure (i.e. culmination of minor daily hassles) [14]. A life change may be the birth of a preterm infant or transition to the role of motherhood, whereas chronic stress may relate to demographic variables, such as financial burden, relationship strain, or social discrimination. Researchers have shown that mothers with a newborn in the NICU describe this as an extremely stressful experience [15-18], and there is a positive linear association between high stress perception and severe depressive symptoms and poor sleep quality in mothers with preterm infants [19-21].

Not only are depression and stress positively related to each other, but these complaints are also associated with sleep disturbances. Sleep is considered one of the body's means of restoration; it is a behavior that influences the physiologic function and psychological well-being [22-27]. Sleep disturbances are prevalent in both mothers with healthy newborns [28, 24] and mothers with preterm infants [26]; sleep problems, whether prolonged sleep onset or disrupted sleep, are commonly reported by the mothers with PPD [1, 29].

Current literature has addressed the relationships between PPD, stress, and sleep, albeit much of the available information focuses on the mothers of healthy term newborns [30, 31]. Limited literature exists for mothers with a preterm infant, and less is known about their rates of postpartum depression, stress, sleep disturbances, and well-being while their infant remains in the NICU. Compared to the general population, mothers with an infant in the NICU may be more vulnerable to depressive symptoms due to stress they endure in association with their preterm infant's medical conditions [16]. This study aimed to compare perceived stress, sleep characteristics, and well-being (fatigue, health-related quality of life) in NICU mothers categorized as having high or low depressive symptoms. The following three hypotheses were tested in this study. Compared to mothers of NICU infants with self-reported low depressive symptoms (EPDS < 13), the mothers with high depressive symptoms (EPDS ≥ 13) would:

1) Report a higher stress perception in both global (i.e. daily life experience) and situational (i.e. infant's hospitalization) stress.
2) Experience more sleep disturbances (self-reported sleep quality and actual total sleep time) during their early postpartum stage.
3) Self-report poorer well-being (i.e. fatigue and health-related quality of life).

2 Methods

2.1 Design and study participants

This study used a cross-sectional comparative study design and included the baseline data from a feasibility study [26] and a pilot study [32] of two-phase randomization trials examining the effects of bright light therapy on sleep and depressive symptoms among the mothers with an infant in the NICU. A convenience sample of 55 mothers from three urban hospitals in the southeast United States completed the Phase I protocol during the postpartum 10^{th} to 13^{th} days while the infants were hospitalized and the mothers slept at home. Mothers included in the study were at least 18 years old, able to read and speak English, and had given birth to a singleton preterm infant weighing less than 2,500 gram who required admission to the NICU. Mothers with a self-reported history of affective illness or diagnosed sleep disorders, as well as those currently

using medications to alter sleep or mood, were excluded. Additional exclusion criteria included 1) mothers who were shift workers, 2) mothers who experienced a complicated delivery course, and/or 3) mothers who were allergic to metal (thus unable to wear the wrist actigraphy).

2.2 Instrumentation

2.2.1 Measurement of depressive symptoms

Depressive symptoms were measured with the Edinburgh Postnatal Depression Scale (EPDS) [33]. This is a 10-item questionnaire which measures depressive symptoms experienced over the past week. Items give examples of how a woman has felt, and she is asked to respond 0-3, indicating "no, not at all" or "yes, most of the time." Responses are summed for a total score ranging from 0 to 30; higher scores indicate greater depressive symptoms. The cut-off score of 12/13 is recommended to identify women with major depression. This tool is widely used with both antepartum and postpartum populations and has been validated in multiple languages and ethnic groups [34]. The Cronbach's alpha in this study was .89.

2.2.2 Measurement of stress

Participants' reports of stress were measured using the Perceived Stress Scale (PSS) and the Impact of Events Scale (IES). Research has shown that there may be a variety of sources of stress for mothers with infants in NICU [19]; thus measurement of stress with both PSS and IES at two weeks postpartum attempted to capture this variable. The PSS is a 10-item tool that measures global stress. The questions are general in nature and ask the participant to consider how she has felt over the preceding month. The responses are summed for a total score ranging from 0-40 with a higher score indicating higher perceived stress [35]. The Cronbach's alpha in the current study was .85. Situational stress was measured by the Impact of Event Scale (IES), which is a 15-item Likert type scale with a higher score indicates higher situational stress [36]. In this study, the mothers were asked to indicate their stress during the past week that was directly related to having a hospitalized infant. The Cronbach's alpha of the IES in the current study was .80.

2.2.3 Measurement of sleep

Sleep data were collected from the General Sleep Disturbance Scale (GSDS) [37] and wrist actigraphy. The GSDS is a 21-item self-reported measurement for sleep disturbances. Participants were asked to indicate the number of days (0-7) the described problem occurred in the last week. A mean value ≥ 3 for the total scale or any of the subscales indicates clinically significant sleep disturbance. The seven GSDS subscales address 1) sleep quality, 2) sleep latency, 3) sleep quantity, 4) sleep maintenance, 5) early awakening, 6) use of medications, and 7) impact on sleepiness and daytime functioning [37]. The GSDS has been used in studies for postpartum women and has sound psychometric properties. The Cronbach's alpha for the whole scale in the current study was .82.

Objective sleep data was collected using wrist actigraphy, which is a non-invasive motion sensor monitor (Mini Motionlogger, Actigraphy, octagonal motionlogger, Ambulatory Monitoring Inc., Ardsley, N.Y.). This measure provides information about the participants' nocturnal total sleep time and sleep fragmentation (wake after sleep onset). Wrist actigraph has been documented as a valid and reliable measurement for assessing sleep in adults [38]. Mothers were asked to wear the wrist actigraph on their non-dominate hand for a consecutive 2-3 days.

2.2.4 Measurement of well-being

Maternal well-being was measured by the Lee Fatigue Scale (LFS) [39] and the Medical Outcomes Study 36-item Short-Form Health Survey, version 2 (SF-36v2) [40]. The LFS was used to determine participant's morning fatigue level [39]. The original LFS includes an 18-item Likert type scale; to reduce burden for the study participants, only 7-item of the fatigue questions were included in this study. Respondents are asked to indicate their level of fatigue, ranging from 0 (not fatigue at all) to 10 (extremely fatigue). Higher scores indicate a higher fatigue severity; a cut-off point of 3.2 for fatigue indicates a moderate tiredness [39]. The Cronbach's alpha for the LFS was .89 in the current study.

The SF-36v2 was used to measure the health-related quality of life (H-QOL). This is a general health survey that assesses one's overall health status, functional status and health-related quality of life. It has 36 items that constitute eight subscales providing a mental and physical health profile [40]. The survey's subscales include 1) physical functioning, 2) role physical, 3) bodily pain, 4) general health perception, 5) vitality, 6) social function, 7) role emotional and 8) mental health. The first four subscales represent the physical component score, and the other four subscales represent the mental component score. Items of the mental and physical scales are summed and standardized to a 0-100 range with scores below 50 indicating below average health. For this study, raw scores were converted to Z scores (norm = 0) and age-matched national norms were used. The Cronbach's alphas were .85 for physical health and .84 for mental health in the current study.

2.3 Procedure

The Institutional Review Board approvals were obtained from the University and three participating facilities. Women who met the inclusion criteria were identified by chart review. The trained research assistant spoke with the bedside nurse to determine if there were any psychosocial problems before she approached the potential study participants. After completing an informed consent, two sets of data—wrist actigraphy and self-reported data—were collected during the second week postpartum. The wrist actigraphy data were collected for two consecutive days in the feasibility study but three consecutive days in the pilot study; with this exception, the protocol of the two studies was the same. Following the objective sleep monitoring, the mothers completed an array of psychometrically sound questionnaires. Mothers received either a baby blanket or a $50 gift card and a sleep hygiene booklet after they completed the two-phase study.

2.4 Statistical analysis

A software program, Action 4, was used to analyze the objective sleep data, including total sleep time (TST) and wake after sleep onset (WASO). Three mothers' objective sleep data were not available due to sleep monitor malfunction; the average of the 2-3 day objective sleep data were used in further data analysis. Descriptive statistics were used to summarize sample characteristics, including age, ethnicity, education, sleep characteristics, perceived stress, fatigue, energy, depressive symptoms, and H-QOL. Normality of each variable was examined before further data analysis. Mothers were categorized into high (≥ 13 EPDS total score) and low (< 13 EPDS total score) depressive symptom groups based on the cut-off point of 13. Independent t-tests were used to compare the differences between the two groups of mothers in selected variables.

3 Results

3.1 Description of main variables

The level of depressive symptoms for this sample was high, with an EPDS mean score of 13.6 (SD = 5.6); however, no mother answered affirmative to item #10 which indicates thoughts of self-harm. After examination of the sample as a whole, we divided participants into two groups for further examination. Based on the EPDS score, a total of 21 mothers were categorized into the low-depressive symptoms group, and 34 were categorized into the high-depressive symptoms group. Demographics of study participants as the total sample and categorized by depressive symptoms are shown in Table 1**;** there were no statistically significant differences in the demographic characteristics of the women between two groups. The majority of the women were of Black/African-American ethnicity (69.1%). Participants were on average 25.5 (SD = 6.1) years of age with a mean educational level of 14 (SD = 3.4) years of school. Table 2 describes the mean and standard deviations for all study variables. Not only was the mean score of the EPDS elevated, but participants also perceived high stress levels in both global stress associated with their daily life and in situational stress related with their infant's hospitalization. The mothers experienced 2 to 3 of days sleep disturbances in the past week according to the GSDS. Furthermore, they scored above the cut-off point of 3 for the sleep quality and daytime function, which indicates they experienced clinically significant poor sleep quality and daytime dysfunction. The participants' nocturnal sleep time, measured from wrist actigraph, was only about 6 hours (379 ± 107 minutes), which was statistically significantly less (*t*

[52] = 2.88, p = .006) than the minimum 7 hours of sleep recommended by the National Sleep Foundation (NSF) [41]. In addition to lower nocturnal sleep time, their sleep was fragmented as evidenced by a high WASO. Not surprisingly, mothers reported a moderate level of morning fatigue, and their H-QOL in both physical and mental components were below the norm.

Table 1. Characteristics of the Study Participants

	Total Sample (N = 55)	**Low Depressive Symptoms (n = 21)**	**High Depressive Symptoms (n = 34)**
Age in years, mean (SD)	25.5 (6.1)	24.7 (5.6)	26.0 (6.3)
Mode of Delivery, n (%)			
Vaginal	27 (49)	10 (47.6)	17 (50)
Cesarean section	28 (51)	11 (52.4)	17 (50)
Ethnicity, n (%)			
White	9 (16.4)	4 (19.0)	5 (14.7)
Black/African-American	38 (69.1)	12 (57.1)	26 (76.5)
Hispanic	7 (12.7)	4 (19.0)	3 (8.8)
Mixed	1 (1.8)	1 (4.9)	--
School in years, mean (SD)	14.1 (3.4)	14.3 (2.3)	14.0 (4.04)
Annual income, n (%)			
> $40,000	8 (15%)	2 (9.5%)	6 (20%)
≤ $40,000	47 (85%)	19 (90.5%)	28 (80%)
Marital status, n (%)			
Married/with a partner	29 (53%)	12 (57.1%)	17 (50%)
Single	26 (47%)	9 (42.9%)	17 (50%)

3.2 Comparison of high and low depressive symptoms women on perceived stress, sleep disturbances, and well-being

Table 2. Comparison Participants with High and Low Depressive Symptoms

Variables (norm)	**Total Sample N = 55 Mean (SD)**	**Low Depressive Symptoms (EPDS < 13) n = 21 Mean (SD)**	**High Depressive Symptoms (EPDS ≥ 13) n = 34 Mean (SD)**
GSDS whole scale (<3)	2.4 (.94)	2.2 (.82)	2.5 (1.0)
sleep quality (<3)	3.29 (1.9)	2.90 (1.7)	3.53 (1.9)
daytime sleepiness (<3)	3.20 (1.4)	2.97 (1.4)	3.35 (1.5)
TST (minimum 420 minutes)	378.3 (105.6)	387.8 (107.4)	372.9 (105.9)
WASO (<10%)	20.0 (12.1)	24.3 (13.3)*	17.5 (10.8)*
PSS (<13.7)	17.5 (7.6)	12.6 (6.6)**	20.5 (6.7)**
IES (<9)	31.2 (13.0)	25.0 (14.1)*	35.1 (10.7)*
LFS, morning fatigue (<3.3)	4.0 (1.8)	3.6 (1.9)	4.2 (1.7)
SF-36v2-physical (0)	-0.87 (.96)	-0.65 (.07)	-1.01 (.94)
SF-36v2-mental (0)	-.72 (1.27)	0.11 (.75)**	-1.23 (1.25)**

Notes. EPDS= Edinburgh Postnatal Depression Scale; GSDS= General Sleep Disturbance Scale; TST= Total Sleep Time; WASO= Wake After Sleep Onset; PSS= Perceived Stress Scale; IES= Impact of Events Scale; LFS= Lee Fatigue Scale; and SF-36v2= Medical Outcomes Study 36-item Short-Form Health Survey

*p < .05; **p < .01

Once dichotomized to the depressive symptoms groups, we compared the differences in perceived stress, sleep disturbances, and well-being between the mothers who reported clinically significant depressive symptoms to those with

fewer depressive symptoms. The first hypothesis was supported; mothers with higher depressive symptoms perceived higher stress level, regardless of global or situational stress distinction ($p < .05$). Mothers in both groups perceived an abnormal situational stress level (above cut-off point); however, for the global stress, only the mothers with higher depressive symptoms scored above the cut-off point.

The second hypothesis was not supported as mothers with high depressive symptoms did not experience more sleep disturbances compared to those with low depressive symptoms during the early postpartum stage. To our surprise, WASO was higher in those with less depressive symptoms mothers ($p < .05$) compared to their counterpart of mothers with greater depressive symptoms. In a study of sleep fragmentation and depressive symptoms [24], total wake time, instead of WASO, was found to be a significant predictor for postpartum depressive symptoms. The researchers commented that WASO may not be the most reliable measure to assess wakefulness in the first three months following childbirth as a mother may awaken to breastfeed or pump her breasts, go to the restroom, or simply check the infant's status [24]. We did explore whether awakening to pump breast milk contributed to the higher WASO for mothers, but this resulted a null finding. It is important to mention that both groups of mothers slept less than 6.5 hours, but the mothers with high depressive symptoms averaged 15 minutes less and self-reported a clinically significant poor sleep quality and daytime functioning compared to mothers with low depressive symptoms.

Lastly, the third hypothesis was partially supported as only the mental component of H-QOL measured by the SF-36v2 revealed a statistically significant difference between the two groups of mothers. We further explored the differences among the eight subscales in the SF-36v2. Among the four subscales in the H-QOL physical component, the mothers with higher depressive symptoms reported a significant lower H-QOL in role physical (t [53] = 3.3, p = .002) and bodily pain (t [53] = 2.5, p= .02) than the mothers with less depressive symptoms. As expected, mothers in the high depressive symptoms group reported a statistically significantly lower H-QOL in all four subscales in the H-QOL mental component: vitality (t [53] = 2.8, p = .008), social functioning (t [53] = 2.99, p = .004), role emotional (t [53] = 3.4, p = .001), and mental health (t [53]= 5.0, $p < .001$).

4 Discussion

The purpose of this study was to compare stress, sleep, and well-being based on the report of depressive symptoms for mothers with infants admitted to NICU. The prevalence rate of postpartum depressive symptoms in this study was nearly 62%, which is higher than self-reported depressive symptoms the CDC [42] found among the general postpartum population (11.7%-20.4%) and the mothers with infants in NICU (14.6-27.8%). The majority of the participants were black/African American, yet when categorized by EPDS scores, the number of black/African American women with high depressive symptoms was more than double the number reporting low depressive symptoms (n = 26 and n = 12, respectively). Examining the group assignment in the other ethnic groups, there was essentially even distribution. Racial difference alone has not consistently been recognized as a risk factor for heighten depressive symptoms among postpartum women [43] rather it may be a combination of limited financial status and social support, both potential stressors. Mothers in this study reported high stress, poor sleep, and poor well-being, suggesting that mothers with a preterm infant cared for in the NICU are particularly vulnerable to depressive symptoms. These data further support the suggestion that hospital staff and healthcare providers should pay attention to maternal well-being while the preterm infants were still hospitalized. This also has implications for mothers and infants transitioning to home settings, a transition that could be challenging for mothers with poor well-being.

As anticipated, compared to the women with less depressive symptomatology, women with greater depressive symptoms also perceived higher stress. Our findings were consistent with literature that mothers with higher stress have greater incidence of PPD symptoms [12]. Increased stress is a known risk factor for development of PPD [44]. The global stress for the mothers with low depressive symptoms remained below the accepted norm for the PSS, yet the measure of situational stress (IES) was remarkable with both groups well above the accepted norm (< 9). The difference in report of global and

situational stress may be explained by the association of chronic stress and depression [10]. The acute stress of the hospitalized infant may not be a depression trigger for a woman with normal global stress; however, for the woman who already has clinically significant global stress, the event stress may contribute to presentation of depressive symptoms. Both factors—depressed mood and stress—serve to compromise a mother's ability to interact and learn in a new environment such as the NICU or as she transitions into caring for a preterm infant. In addition, depressive symptoms and heightened stress during NICU hospitalization increase the likelihood of persistent depression after discharge and heighten the risk of developing of posttraumatic stress symptoms [4, 7, 21]. These findings support the need for assessment of a mother's prenatal stress while her infant is in the NICU and indicate the importance of stress management techniques, such as maternal reliance on existing social support networks or developing new coping strategies.

There was a slight difference in the sleep reports of mothers with high and low depressive symptoms which is consistent with findings from studies of depressed and nondepressed women with healthy newborns at home. These reports also revealed a positive association with depressive symptoms and altered sleep [24, 45]. With the exception of WASO, however, our findings did not show a statistically significant difference in the sleep measurements when comparing women based on our a priori cut-off for high or lowdepressive symptoms. Further exploration is required to determine why WASO is higher in those with low depressive symptoms. Interestingly, when we considered depressive categorization based on the median split of 14, we found a significant difference in sleep characteristics of mothers with high and low depressive symptoms. Both groups of mothers failed to meet the NSF's recommendation of 420 minutes of nocturnal sleep time and fell short of the average sleep time for postpartum women (7.2 ± .95 hours) with a term healthy newborn [46]. Our study population was distinct from Montgomery-Downs and colleagues' normative sleep findings that included non-depressed, predominantly Caucasian mothers with healthy full-term infants. The sleep deprivation our mothers experienced may ultimately have a negative impact to their health with a persistent deficiency of nocturnal total sleep time.

Mothers in the current study experienced moderate fatigue, positively associated with higher depressive symptoms, which is consistent with a prior study in mothers with a term infant [30]. The report of fatigue did not reflect a statistically significant difference between groups; however, mothers with greater depressive symptoms reported clinically significant morning fatigue severity but not the mothers with less depressive symptoms. Women in both groups described their physical well-being below that of age-matched national norm; however, there was no statistically significant difference between the groups. This may be partially explained by the timing of the measurement. Discharge instructions following childbirth typically advise postpartum women to modify activities until six weeks postpartum, with recommended restriction on activities of daily living. Although no participants had a complicated post-delivery course, 51% had infants delivered via Cesarean section and accordingly limited their activity. Therefore, recuperation from delivery may explain the difference in the subscales of the SF-36v2 such as physical role and vitality. While the final hypothesis that women with greater depressive symptoms would have poorer well-being was not supported by all measures, the findings do highlight clinical differences in women with high and low depressive symptoms. Depressive symptoms, high stress, and inadequate sleep may all compound to compromise a mother's general well-being.

The study findings contribute to the knowledge of the differences in stress perception, sleep, and well-being between depressed and non-depressed women during the early postpartum period while their infants received care in the NICU; although, findings should be considered in light of the small sample size. Other limitations to this study include the secondary nature of the data gathered during the second postpartum week for the purpose of an intervention study. During the second week postpartum, a mother may still be experiencing postpartum blues. One may argue that this is still a great time of transition, especially within the NICU population, and stress and depressive symptom scores may be somewhat inflated. Additionally, chronic stress is an accepted risk factor associated with preterm birth, and this stress may in fact be a contributing factor to the preterm birth. Thus, it is possible that women with preterm infants may have higher baseline levels of stress which may have impacted these results. Although women with history of affective disorders were excluded, there was not a mechanism to control for those with heightened prenatal stress.

5 Conclusion

The transition to motherhood is one of life's many transitions, yet this transition may disrupt the entire balance of a woman's life. Mothers of healthy newborns describe feelings of conflict, uncertainty, fear and emotional fluctuation [47]. For the women who give birth to preterm infants, these feelings may be amplified and the transition to the new role may pose a greater challenge. The experience of having a newborn in the NICU can result in heightened stress, compromised sleep patterns and well-being, and depressive symptoms. These mothers likely require support beyond that of a mother with a healthy, term infant.

In the clinical practice, mothers of NICU infants interact with an entire team of healthcare professionals. While most care involves the infant, the mother and her support system are being observed throughout the infant's hospitalization. Health care providers may make an effort to identify subtle signs and symptoms of stress and depression; however, hospitals may not have a formal assessment to identify potential problems for the mother early in the NICU setting. Nurses who care for the infants in the NICU also have a role in caring for and facilitating a mother in receiving care. Understanding the relationship of depressive symptoms to a mother's report of stress, sleep changes, and general well-being allows for improved assessment of the new mother. Introducing routine screening for PPD and inquiry of stress and sleep patterns can be the first step in recognizing complaints which the mother may attempt to normalize. Screening tools may be easily administered and interpreted and provide an opportunity to discuss manifestations of PPD and treatment options. Considering the greater vulnerability to PPD, clinicians should have a lower threshold for medically treating stress and sleep disturbances in this population. NICU staff can provide educational resources to mothers about getting adequate rest, managing stressors, self-care activities, and access to mental health services or support groups. PPD is not an illness that can be easily identified in all those who suffer, but it is detectable with validated screening measures [48]. Knowledge of PPD and the associated symptoms, along with communication of this information to the NICU healthcare team, can make a difference in the well-being of a NICU mother and in the long run, her preterm infant.

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